

Incorporating Economic Values into Remedial Options Analysis

Norman Meade, *NOAA*

&

Theodore Tomasi, *Entrix, Inc.*

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Incorporating Economic Values into Remedial Options Analysis

- Methods for evaluating both positive and negative effects of remedial options during risk management decision-making
 - conceptual approaches
 - using dollar metrics
 - using ecological metrics
- Scaling extent of restoration to offset impacts from residual risks
- Technical and Institutional Challenges

Risk Management Challenges

- Many sites do not have either uniformly extreme or minimal risks
 - Many sites in a “gray area”
- Conservatism in HQ implies need to consider weight of evidence in remedial decisions
 - Need for judgement and balancing effects in risk management increasing
- Few accepted formal tools for risk management

Risk Management is Evolving

Ecological Effects of Remedial Options

- The Ecological Risk Assessment calculates the risks of existing conditions
- Remedial actions reduce these risks but may introduce new ones
 - Physical impacts from remediation
 - New exposure pathways
- Spatial and temporal effects important

Economic Analysis of Benefits and Costs

- Basic problem is measurement of effects in a common unit so they can be summed to arrive at a net effect
- Valuation methods apply to services provided by natural resources
- Can measure effects in dollars via a “willingness-to-pay/accept”
- In some cases can measure effects with an “ecological metric”

Why Measure Benefits and Costs?

- A means for making best possible information available to the decision makers
- Doesn't make the decision, may be an important input to decision-making process
- Not all benefits and costs are relevant (to the remediation decision maker)
- Difficult to do well

Money Metric Approach

- Explicitly and systematically can account for all measurable costs and benefits
- Similar to private investment analysis but emphasis is on social costs and benefits
- Social costs and benefits apply to everyone in a defined population
- Analysts and clients decide what benefits and costs to include

Benefits of Remediation

- Vary according to perspective
- For remedial decision makers: mainly cancer and ecological risk reduction
- For local communities: a complex mixture of health, income, ecological, recreational and passive use values
- For nation: primarily passive uses
- For RPs: reduction in NRD liability, good corporate citizenship and increase in “good will”

Costs of Remediation

- Diverting resources from other uses in economy (measured as dollar cost)
- May disrupt existing ecological services
- May introduce new ecological risks/injuries

Measuring Benefits In Dollars

Regardless of Perspective:

- contaminated sediments require economic methods designed to measure both market and non-market values
- some benefits are difficult and/or costly to estimate, i.e. human health, ecological services, endangered species, passive use, etc.

Benefit Elements

- Example: health benefits
 - reduction in medical treatment costs (market value)
 - reduction in pain and suffering (non-market value)
 - reduction in lost wages (market value)
 - reduction in mortality (market and non-market value)

Benefit Elements

(continued)

- Example: benefits from a reduction in fish reproductive injury
 - increase in fish biomass on average leads to an increase in the value (market and non-market) of services: food (for humans and non-humans); recreation; and passive uses
 - can also be valued in “ecological currency”

Economic Benefits Methods

- Market Values
 - reduction in out of pocket expenses; increase in producer profits; increases in employment/income; increases in property values
- Non-market Values
 - travel cost recreation demand models; survey-based stated preference techniques, including contingent valuation and stated choice

Cost Effectiveness

- Closely related to benefit cost analysis
- Holding benefits constant, identify the least costly way to accomplish sediment removal
- Given a fixed budget, how to maximize sediment removal benefits

Remediation and Natural Resource Damage Assessment Economics

- Under CERCLA, Trustees are required to recover “damages for injury to, destruction of, or loss of natural resources, including the reasonable costs of assessment” (section 107(a)(4)(C))
- Remediation benefits lead directly to reductions in NRDs (residual to remediation)
- Quantification methods are similar
- NRDAs cannot include health costs and private losses

Natural Resource Damage Assessment Goals

- To restore federal and state trust resources that have sustained injury as the result of accidental spills or chronic discharges of hazardous substances (CERCLA) or oil (OPA)
- To make the public whole for interim loss of use of natural resources
- Recovered sums must be used to restore, replace or acquire the equivalent of the injured natural resources and to reimburse agency assessment costs

Ecological Metric Approach

- A method for assessing the positive and negative ecological effects of alternative remedial actions
- An economic model for decision-making
- Does not use dollars as metric for measuring effects
- Applies to site-level analyses, not policy-level analyses

Ecological Metrics

- Focuses on the suite of ecological services provided by the natural resources
- Based on habitat assessment methods developed by:
 - U.S. Dept. of Interior
 - NOAA
 - Corp of Engineers
 - Fish and Wildlife Service
- Adaptation of methods used in NRDA (Habitat Equivalency Analysis)

Ecological Services

- Ecological services are beneficial outcomes of bio-physical functioning in ecosystems
 - valued **directly** or **indirectly** by people
- Ecological risk drivers can impair functioning and reduce services
- Ecological services are related to, but not necessarily measured by, risk assessment endpoints

Ecological Services of Sediments

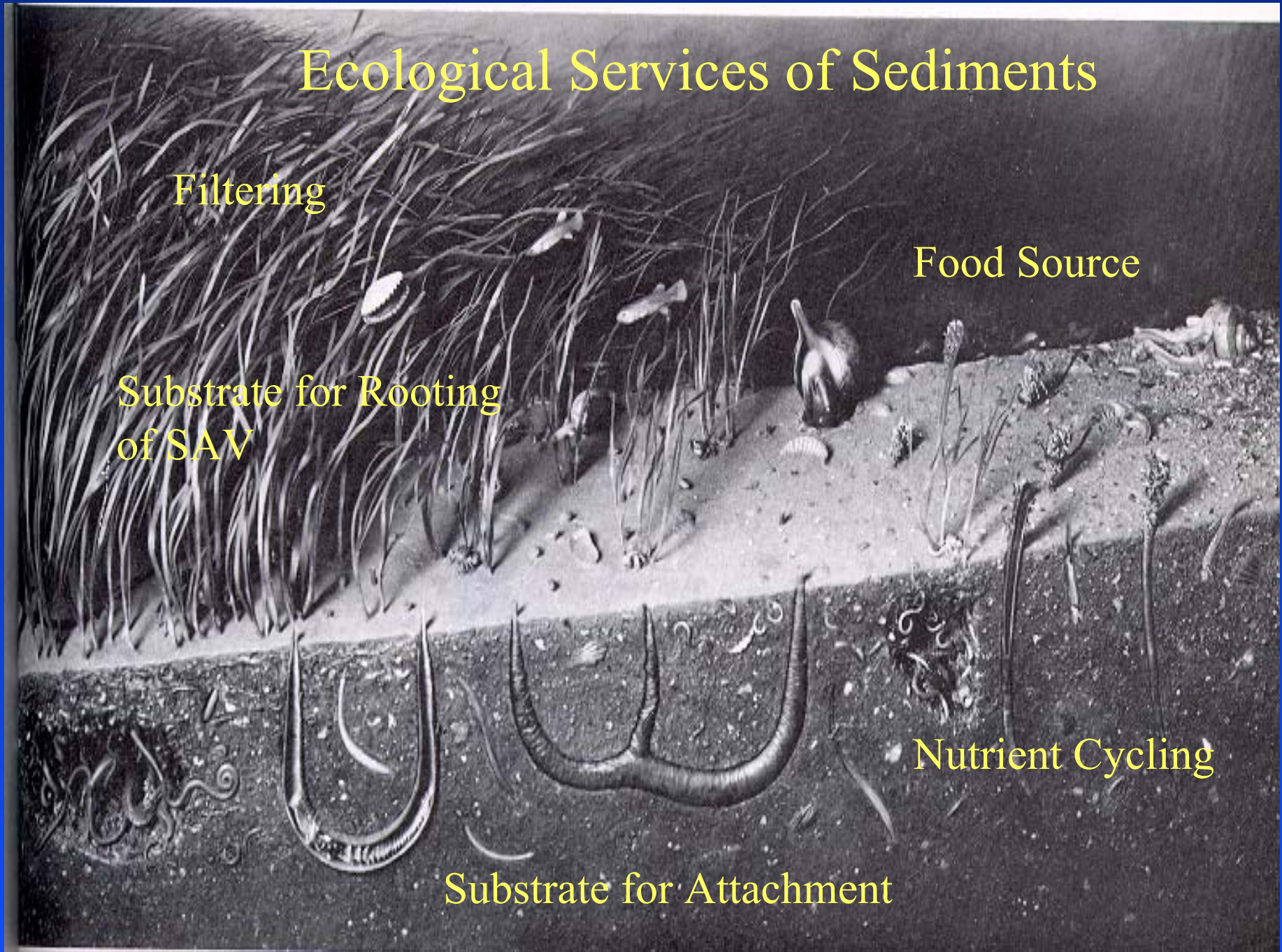
Filtering

Food Source

Substrate for Rooting
of SAV

Nutrient Cycling

Substrate for Attachment



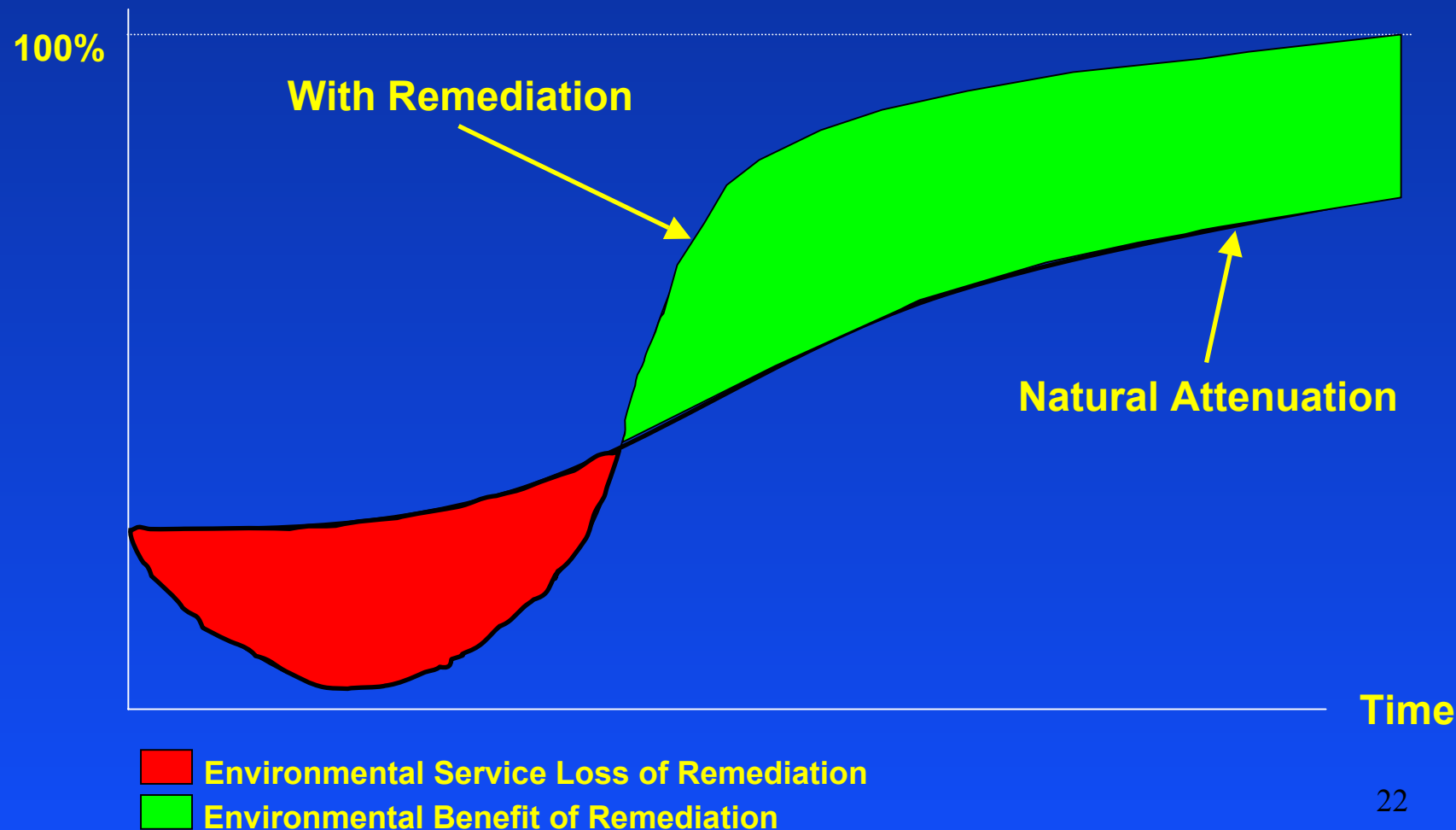
Compare Remedial Alternatives

Example:

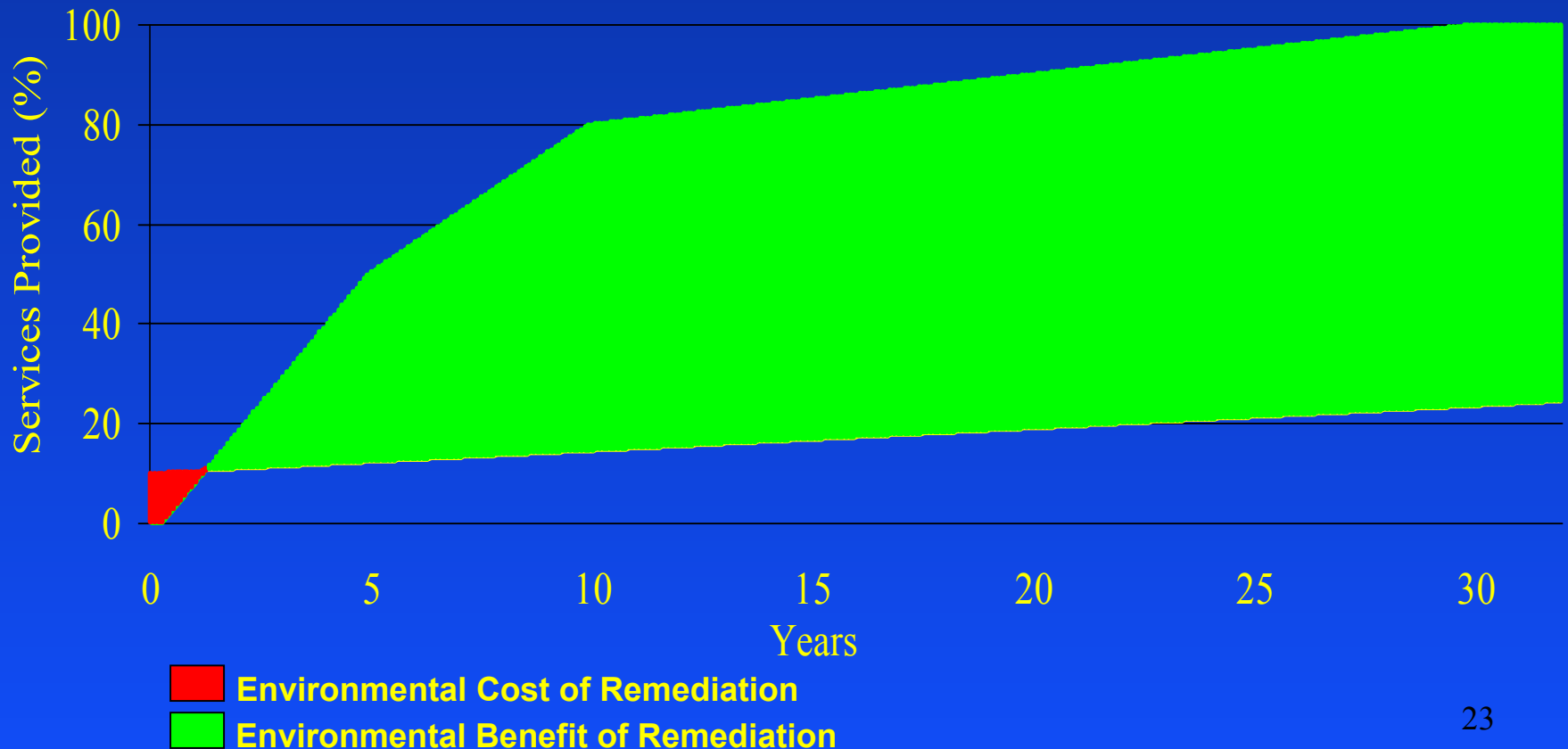
Active Remediation -v- Natural Attenuation

- With Remediation
 - Immediate physical impacts imply an initial reduction in services *but* potential eventual gain in services by eliminating any residual risks
- Natural Attenuation
 - No immediate physical effect *but* perhaps long period of reduction in services due to residual risks

Ecological Services

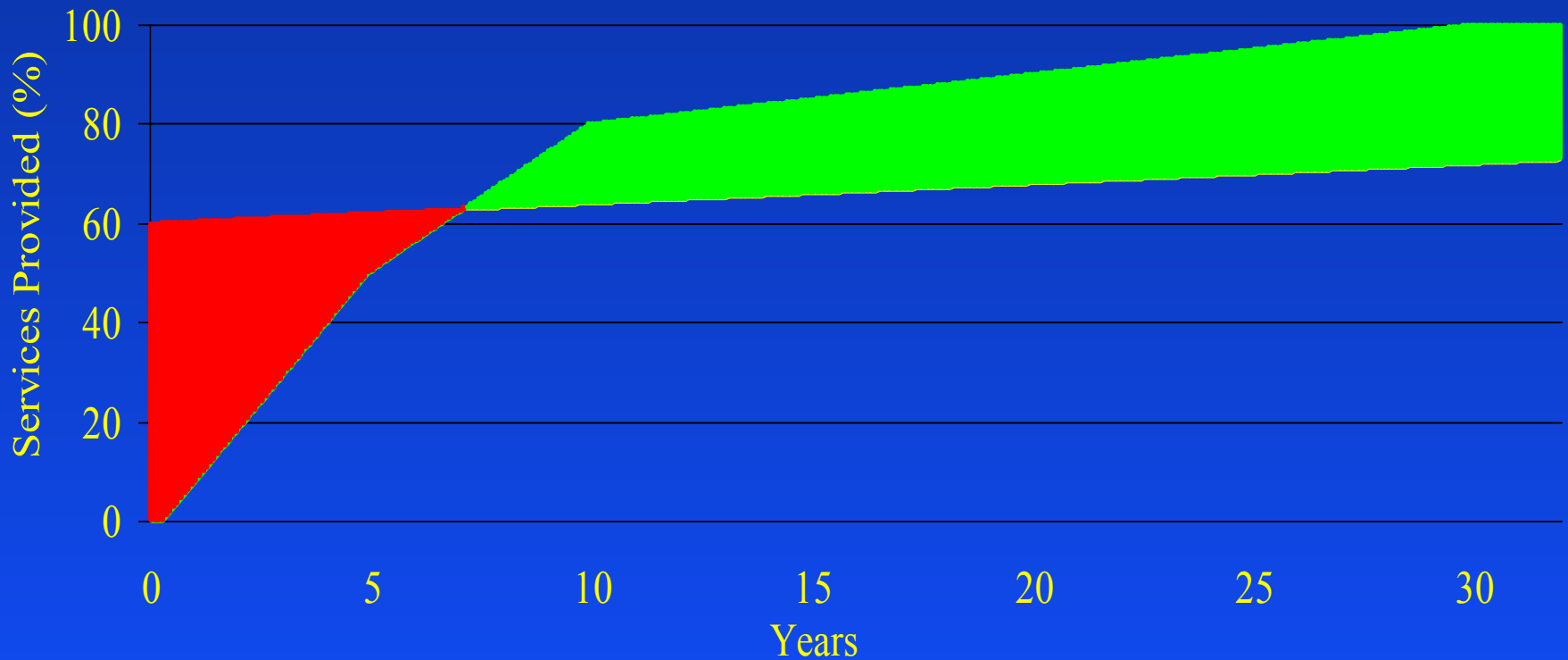


Benefits and Costs of Remediation at Chemical Hot Spot (Current Services 10%)



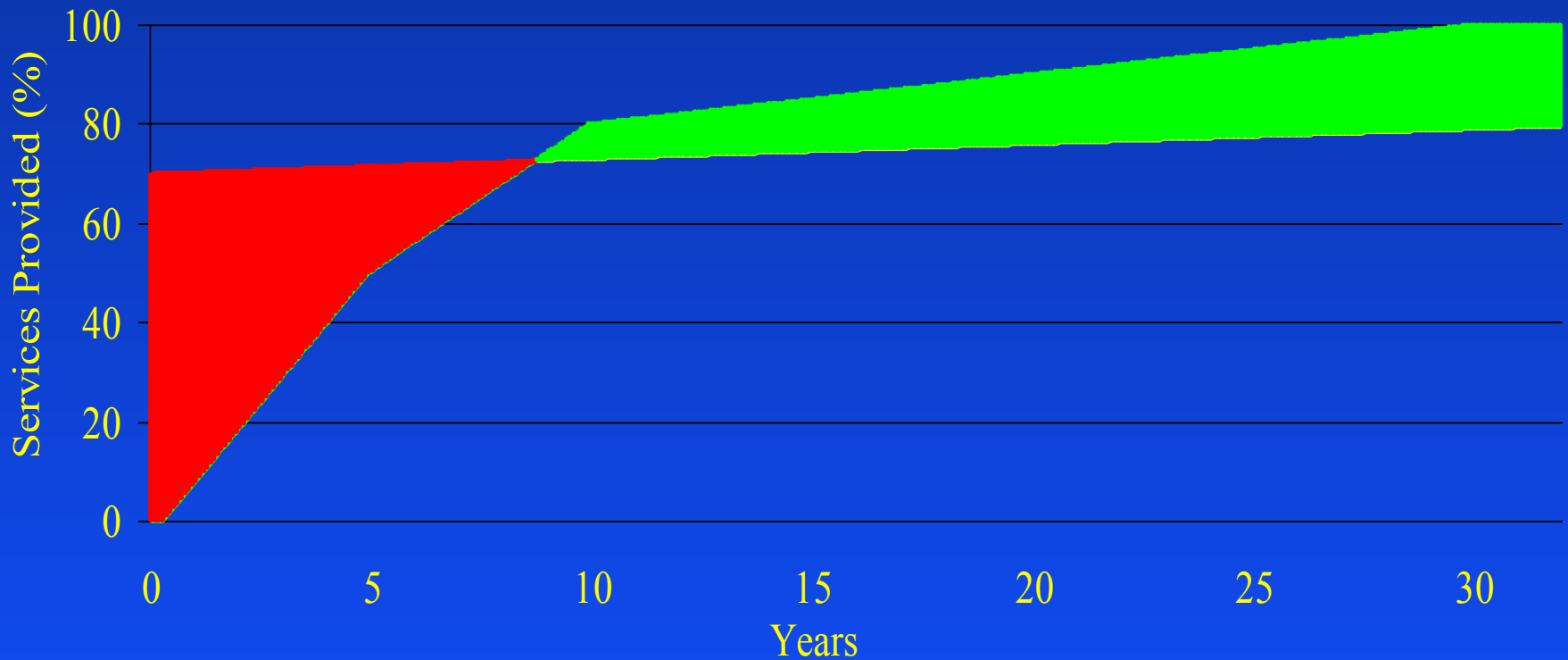
Benefits and Costs of Remediation

Initial Services 60%

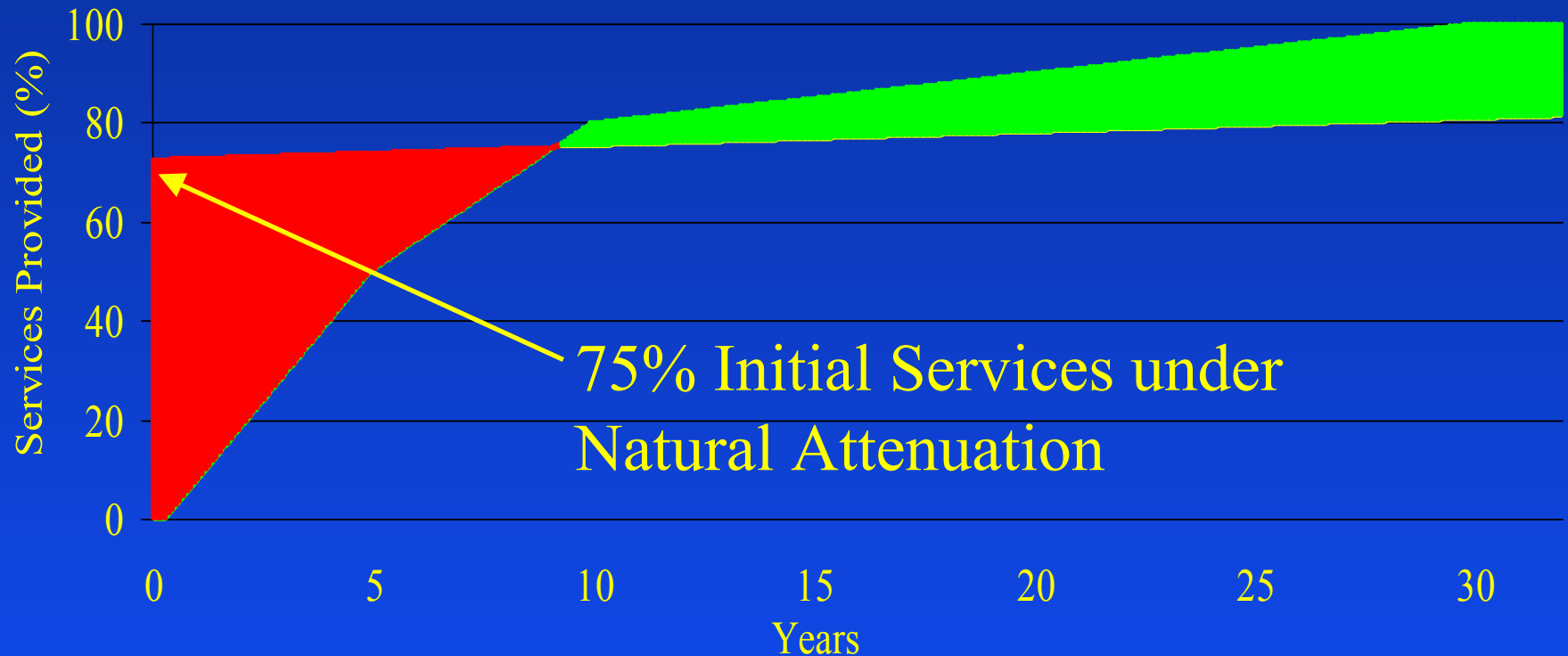


Benefits and Costs of Remediation

Initial Services 70%

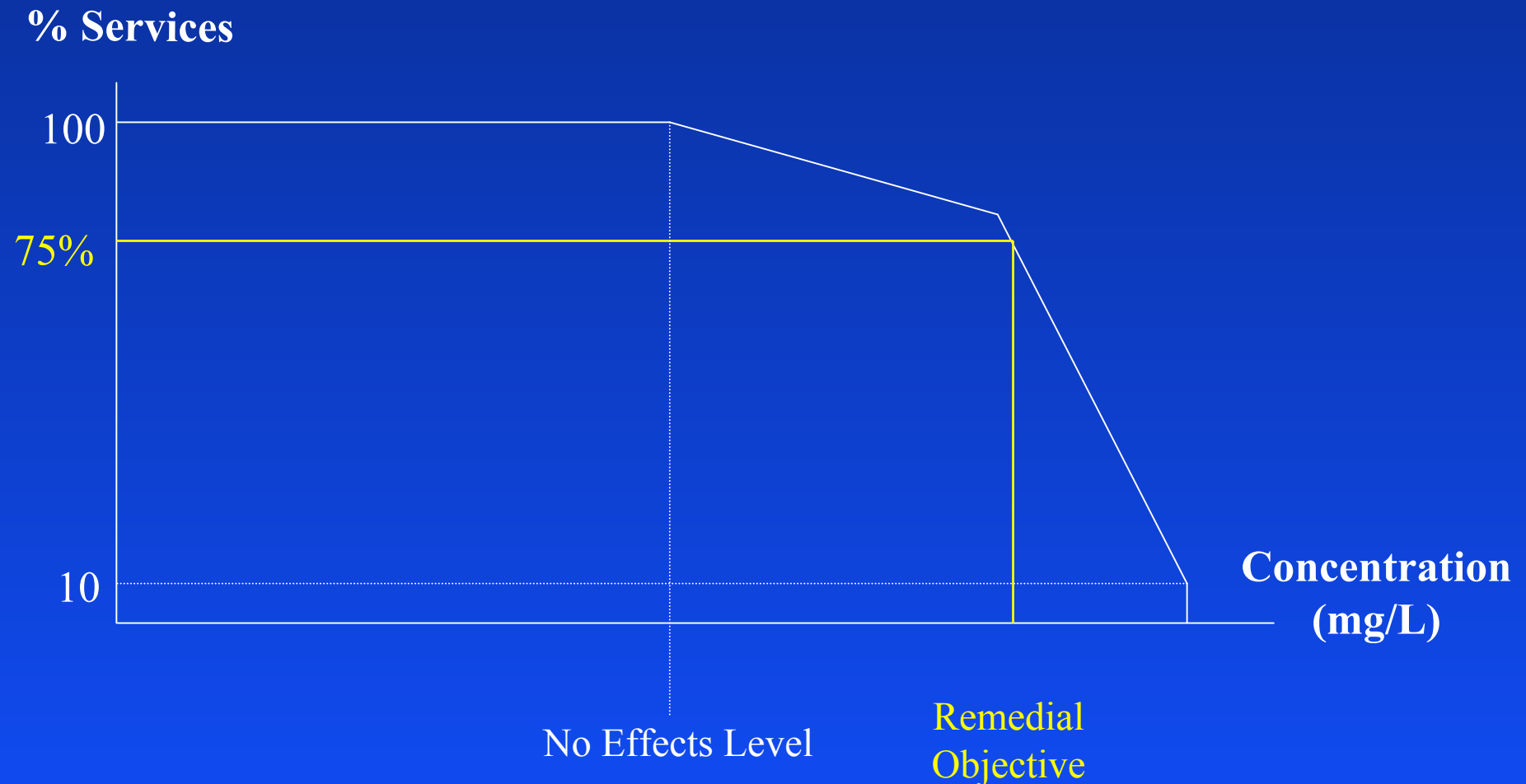


Benefits and Costs of Remediation Equated



At lower chemical concentrations (higher initial services) environmental costs of remediation exceed benefits

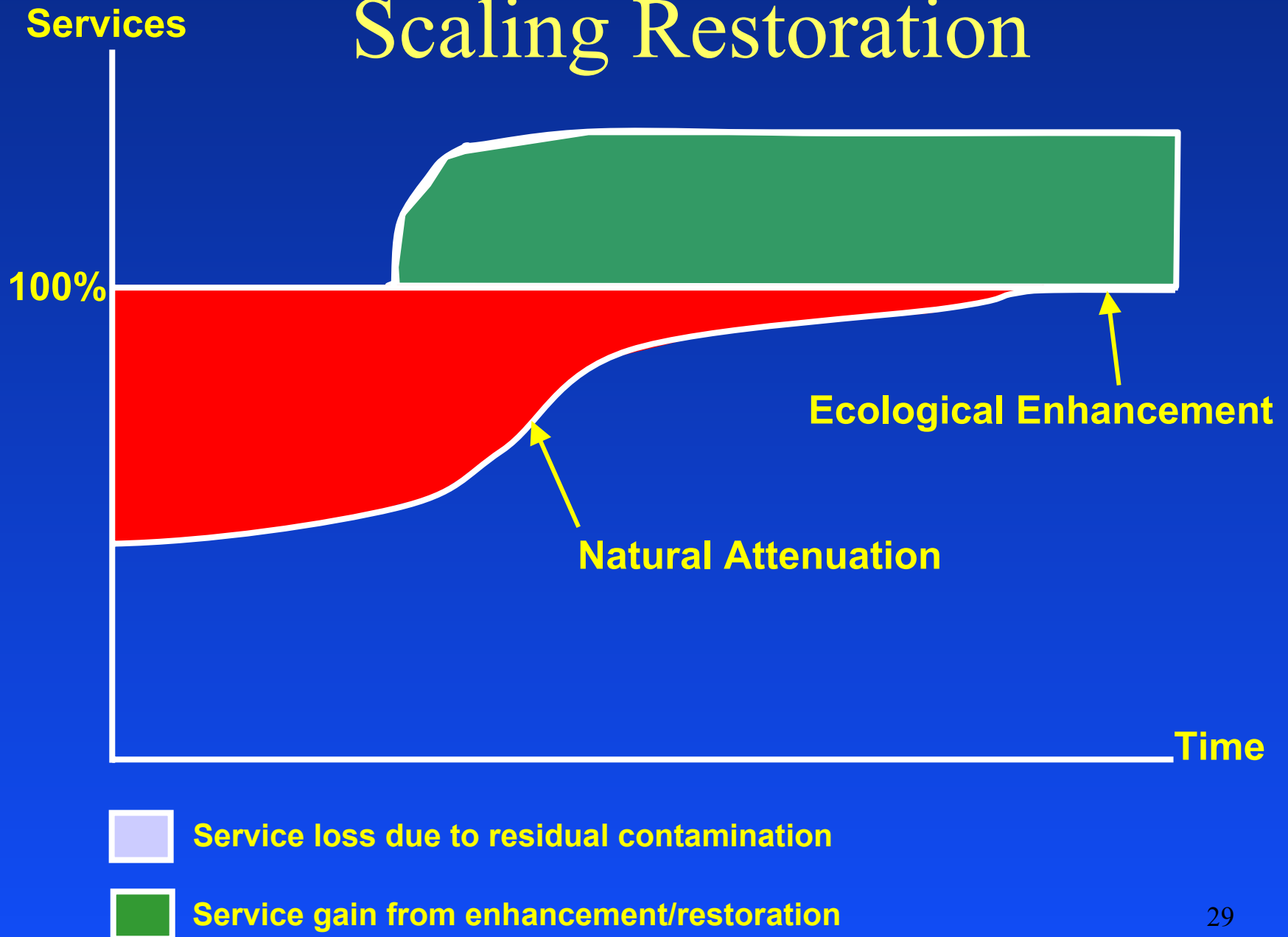
Services — Concentration Curve



Scaling Restoration Actions

- If have residual harm under natural attenuation, may not reach baseline for a considerable time period
- Can compensate for this loss by some another action to enhance services
- Can scale restoration action using Habitat Equivalency Analysis in NRDA process

Scaling Restoration



Benefits of Analysis

- Method for integrating multiple sources of ecological risks in risk management decisions
- Facilitates a science-based approach to risk management.
- Optimizes environmental benefits of remedial decisions
- Can be used to integrate assessment and management of remedial and NRD liabilities

Need for Integration of Research in Several Areas

- Research needed to establish dose - response (services-concentration) curves
- In ERA the assessment endpoints are related to some site services; measurement endpoints tend to be narrowly defined
- Ecological services should be included in habitat assessment methods

Institutional Barriers

- The value conundrum
 - trade-offs among services & weights for adding across services necessarily reflect value judgements
- Distinct roles of FS (regulatory) and NRD (trusteeship) tends to limit integration of approaches